FOSSIL MAMMALS IN NORTH AMERICA

The Extinct Mammalian Fauna of Dakota and Nebraska; together with a Synopsis of the Mammalian Remains of North America. By Dr. Leidy. With an Introduction on the Geology of the Tertiary Formations of Dakota and Nebraska; with a map. By Dr. Hayden. (Philadelphia, 1869.)

DR. LEIDY'S new work on the extinct mammalia and fauna of Dakota and Nebraska, to which is appended a Synopsis of the Mammalian Remains of North America, fills a wide gap in Palæontology. It occupies the whole of the seventh volume of the Journal of the Academy of Natural Sciences of Philadelphia, and is accompanied by a preface on the geology of the Tertiary Strata of Dakota and Nebraska, by Dr. Hayden. Altogether it forms the most important contribution to our knowledge of fossil mammals which has been made since Prof. Gaudry published his famous "Animaux Fossiles et Geologie de l'Attique." These two books, indeed, stand in close relation to one another, for in the one the chief interest centres in the Miocene fauna, which is the subject matter of the other. I propose to give an outline of Dr. Leidy's work, and to show the relation which the American Mammalia bore to those of Europe, from the Miocene down to the "Quaternary," or Post-glacial epoch.

At the close of the Cretaceous period, writes Prof. Hayden, the ocean which had "rolled uninterruptedly across the area now occupied by the Rocky Mountains" began to grow shallow, until at last a long barrier of land gradually rose above the waves, and separated the Atlantic from the Pacific. This elevatory movement culminated in the Rocky Mountain range in the United States, and probably has been going on from the Cretaceous period down to the present day. In the early Tertiary epoch enormous lakes occupied the basin of the Mississippi. The "great lignite basin," for instance, extends far southward, possibly even to California, westward far over the mountains to Utah, and possibly to the Pacific, and northward probably to the Arctic Sea, interrupted here and there by the upheaval of mountain ranges." The strata which testify to the former existence of this great lake, consist of layers of clay and sand, and numerous beds of lignite, varying in thickness from a few inches to twelve or fifteen feet. In its lower portion an oyster is the characteristic fossil, which by its stunted growth implies a change from salt to brackish water, while in the rest of the formation there are freshwater shells of the genera Melania and Corbicula. "The occurrence of immense fan palms, and many other plants now growing only in tropical climates, points directly to the conclusion that along the shores of this great lake there grew most luxuriant forests, equalled only by those now existing in Central America or Brazil." The date of this lignite formation is possibly Eocene, and certainly pre-Miocene. Some of these lakes continued to exist as late as the Pliocene epoch.

The "White River group" of rocks consists of white indurated clays, sandstones, and conglomerate marls and sands, upwards of a thousand feet thick, which occupy an area of at least 100,000 square miles on the Eastern flank of the Rocky Mountains. It is purely a fresh-water formation. In Nebraska it is eroded by pluvial and torrential action into quaint pinnacles and fantastic shapes of every sort, and into deep barren ravines that recall to mind Dr. Falconer's description of some parts of the Sevalik Hills. From the difficulty of traversing the 5,000 square miles which are cut up in this way the district is known to the Canadian voyagers as "Mauvaises Terres," and to the Indian hunters as the "Bad Grounds." It has furnished the larger portion of the Mammalia described by Dr. Leidy, and is unequivocally of Miocene Age. The Loup River Strata resting on the White River group, consist of sand and a few layers of limestone, and contain the remains of land and fresh water Testacea and Mammalia. In Nebraska, the sand is so incoherent that it forms a series of ever shifting dunes, which occupy an area of not less than 20,000 square miles. The remains of Elephant and Mastodon and others show that it belongs to the Pliocene, irrespective of the stratigraphical evidence. The Post-tertiary deposits are represented in the same region by a yellow siliceous marl, most fully developed along the Missouri River, and in the valley of the Plate. It is from three to five hundred feet in thickness, and contains well-known Post-glacial fossils.

In treating of the Mammalia yielded by these different formations, Dr. Leidy has followed the example of Prof. Agassiz in the needless multiplication of species. Naturalists fall into two classes, according to the ideas which they bring to bear on their work: the one fix their attention on the variability and points of resemblance manifested by suites of organic remains, and stretch the name of species as far as it will go; the other give specific value to minute differences of size and form, which, in a larger series of specimens, either recent or fossil, would be found valueless in classification. In this work Dr. Leidy has joined himself to the latter class, and has marked every small variation by a specific, and, in some cases, even a generic name, and by so doing has added, without any necessity, to the heavy burden of synonyms which scientific literature has to put up with. He believes that the American is a "peculiar fauna," and, that even if no difference between European and American fossils can be detected, their geographical separation is evidence that they belong to different species. For example, in the description of a new species, *Equus excelsus*, he admits that "it is not improbable that part of the specimens looked upon as fossils may be the remains of the Mustang, or recent wild horse of our western wilderness." Nevertheless, he holds to his own undefined specific name. This fault is carried to an extreme, in the case of the extinct family Anchitheriidæ. On the small foundation of one tooth, which, "in general proportions and construction," and "in size," is "nearly the same as the teeth of *Anchitherium Aurelianense*," a new genus, Anchippus, is based; while four milk molars, which "in form, mode of insertion, and general constitution and size, bear a near resemblance to those of the same species," constitute the basis of the second new genus Parahippus. This mode of treatment runs more or less throughout the work, and renders it of less value than might have been expected from the importance of the subject-matter. But, nevertheless, it is a mine of information to which Tertiary naturalists will resort for many long years to come.

I will now pass on to the consideration of the leading features of the Miocene fauna. On the borders of the ancient Miocene lake, from which the Mauvaises Terres

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were deposited, lived a most remarkable group of herbivores, all of which were, roughly speaking, less specialised than any now on the face of the earth. The Oreodon, a ruminant about the size of a large domestic sheep, was there in considerable abundance, and must have lived in herds, after the manner of the bison in the neighbouring region. It was an animal of a strangely composite kind; to the molar teeth of a ruminant it added the ulna and radius of a hog; it possessed a cranial and temporal region like that of the camel, and larmiers beneath the orbit as in the Cervidæ and the musk-sheep. Its canines were trilateral and worn like those of a pig, and its dental armature was complete all round. Three closely-allied forms, the Merychochœrus, Leptauchenia, and Agriochœrus, are associated with Oreodon, and form a group which, judged by existing forms of life, stands half-way between the pigs and the ruminants. It is an admirable instance of one of Prof. Huxley's "intercalary types." The camel or lama was represented by two allied forms, the Pœbrothere and Protomeryx, and the musk-deer by the Leptomeryx. The Artiodactyle division was present in very strong force. The Elotherium is allied to the hog, peccary, and hippopotamus. In a full complement of teeth it possessed a canine almost carnivorous in character. It was probably less omnivorous than any of the class now living. The Perchœrus, Leptochœrus, and Nanohyus, form members of the same class, together with the Hyopotamus and the Titanothere, which was possessed of a well-developed and separate ulna and radius. The remains of rhinoceros indicate one, and perhaps two forms, during the American Miocenes. The lowness of the crowns of their teeth, the large development of the incisors, and the absence of any trace of horn-basis on the skulls which have been preserved, imply that they belong to the hornless section Aceratherium, of Dr. Kaup, rather than to the true rhinoceros. Dr. Leidy has very rightly separated Hyracodon from the true rhinoceros, because it has the full complement of teeth in both jaws. The Anchithere represented the horse in this fauna; the Palœolagus the hare; and there were also squirrels, beavers, mice, and hedgehogs present.

There was also a corresponding development of the Carnivora. Two species of Amphicyon performed the function of the living foxes and wolves; the Hyænodon that of the hyæna; while the great Machairodus, and the allied form Dinictis, represented the lions, tigers, and other larger felines.

If this fauna be compared with that of the European Miocenes, several important differences and resemblances may be remarked. The whole group of antelopes, found in such numbers in the classic plains of Pikermi by M. Gaudré, and in central France, are absent. The giraffe also, and the family of the Cervidæ, and the horse, elephant, Mastodon and Hipparion of Europe, are equally absent. Other genera are common to both Europe and America. The *Elotherium Moretoni* of the Mauvaises Terres can scarcely be distinguished from the *E. Aymardi* of the Gironde. The *Anchitherium Bairdi* cannot be distinguished with certainty from the *A. Aurelianense* of France. The rhinoceros and Aceratherium of Eppelsheim and Pikermi find their analogues in the so-called *Rhinoceros occidentalis* and *R. meridianus* of America, while the Hyracodon recalls forcibly to mind the small rhinoceros from Sansan (*Aceratherium Sansanense*). The Lophiodon is also an American form. Of the Carnivores, the *Amphicyon vetus* is the equivalent of the *A. major* of De Blainville from Sansan, while the Hyænodon and the sabre-toothed Machairodus were the scourge of the Miocene herbivores in America as in Europe. The family of the Oreodontidæ, on the other hand, seem peculiar to America, as also the Titanothere and the small carnivore the Dinictis.

This distribution of life throws considerable light on the physical geography of the northern hemisphere during the Miocene period. The absence of the South American forms which were living at the time, the apes, the rodents, and the edentata, implies the presence of a barrier between North and South America, which prevented migration from the one to the other; and this barrier was most probably, as Prof. Huxley remarked in his last address to the Geological Society, an open sea. The forms of life common to Europe and North America imply a continuity of land between those now widely dissociated areas. Mr. Murray believes in the existence of a Miocene Atlantis, which has left the Sarghasso sea as a palpable monument of its existence in the mid-ocean. I should, however, be rather inclined to look for the continuity of land in the direction of Siberia, Behring's Straits, and, it may be, Greenland; and when the recent wonderful discoveries of temperate and sub-tropical vegetation in the now Arctic regions is taken into account, it appears to me extremely probable that the animals migrated from one area to the other by that pathway. But whether this be accepted or not, Prof. Heer has shown that during the Miocene times there was a vast extent of land, and a temperate climate in the now extremely high northern latitudes, which would imply conditions of life favourable for the migration of the Miocene animals. It is impossible to find out with any certainty the direction which the Miocene migration took, whether from America towards Europe and Asia, or *vice versa*. There is, however, one very significant fact to be observed, that the American Miocene fauna is less specialised than the European, or, in other words, that it is of an older type. It contains no true hyænas, nor deer, nor antelopes, nor any of the living genera which first appeared in the Miocenes of Europe. Possibly in point of time, or rather in homotaxy, it was older and more closely allied to the Eocene. The explanation which strongly suggests itself to my mind is that the migration set in from the old world, and that the above-named living genera sprang into being here, and are not found in the American Miocenes, because they had not time to reach that area. Thus the absence of certain extinct genera, such as mastodon and hipparion, may be accounted for. That eventually they found their way thither will be seen in the succeeding part of this essay relating to the Pliocene.

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NAUMANN ON THERMO-CHEMISTRY

Grundriss der Thermochemie. By S. Alex. Naumann. 8vo. pp. viii. and 150; price 3*s*. (Brunswick, 1869. London: Williams and Norgate.)

IT is not altogether without reason that modern chemists are accustomed to point, as a proof of their activity, to the amount of materials they have succeeded in accumulating. The fact, indeed, is sufficiently familiar to most students.

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